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Mechanical Characterization on Processed Coconut Shell Particulate Reinforced Epoxy Matrix Composite

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***Abstract*— Fiber reinforced polymer composites have acquired a dominant place in variety of applications because of their high specific strength and modulus The use of synthetic fibers (glass, aramid, boron etc.) in composites tends to affect environment, on the other hand natural fibers (Coir, jute, flax etc.) are environmentally superior to synthetic fibers The objective of this study is to investigate the synthesis technique and mechanical characterization of processed coconut shell filler particulate reinforced with epoxy matrix..**

Keywords: glass, aramid, boron, Coir, jute, flax

I. INTRODUCTION

LOTS of research was carried out on natural fiber composites. It had become a material of choice as an alternative to other traditional materials and has found applications in many sectors. Since the 1990s, natural fiber composites are emerging as realistic alternatives to glass-reinforced composites in many applications. Natural fiber composites have also claimed to offer environmental advantages such as reduced dependence on non-renewabl energy sources, lower pollutant emissions, lower greenhouse gas emissions, enhanced energy recovery, and end of life biodegradability of components. Thus such superior environmental performance is an important driver of increased future use of natural fiber composites. As a result, a large amount of research has been dedicated to the use of natural fibre as a substitute for glass, carbon and synthetic fibres; driven by potential weight saving, lower raw material price, and ecological advantages of using resources which are renewable. Many research articles have reported the use of various natural fibers, mostly derived from the bast or stem of the plants, including jute, sisal, flax and hemp.

In the area of bio-composite many research has been carried out and some of them are explained below. Those hybrid composite areas were helped to prepare a mono bio-composite with coconut filler and epoxy resin

A research has been carried out on preparation and characterization n preparation and characterization of chemically modified jute–coir hybrid fiber reinforced with epoxy resin. The maximum improvement on the properties was achieved for the hybrid composite containing the jute–coir content of 50: 50.Natural fiber based composite have been successfully manufactured by several methods wet layup, resin transfer molding and finally vacuum assisted resin infusion. The inherent incompatibility between natural fibers and synthetic matrix resulting in poor fibre–matrix adhesion is often an issue which needs to be addressed in order to improve the mechanical performance of the resulting bio-composites. The quality of fiber– matrix adhesion can be enhanced either through surface treatment or via improvement of manufacturing processes.

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II. METHODOLOGY

A. MATERIALS

Instructions The experimental was started with the procurement of the Komeng coconut shell, epoxy resin, hardener, SRM mould and PP. The coconut shell was collected from the coconut farm .The resin used was epoxy resin 3554A with the density of 1.15 g/cm3. The SRM open mould type was used with rectangular shape according standard (ASTM D256) for Izod impact test and dumbbell-shape samples follow the standard ASTM D2099 for tensile test.

B. *Sample preparation*

The shell firstly was weighted using digital weighing machine then it were cleaned with fresh water and lastly dried at room temperature. After that all the coconuts shell were burnt in the oven with temperature ~80°C until 5 minutes so that it become coal or powdered ash. Total number of samples for each mould can produce maximum until 15 specimens in one time. Each mould has a cavity to accommodate the composite samples. Epoxy and hardener were mixed in a container and stirred well for 5–7 minutes. Before the mixture was placed inside the silicon rubber mould (SRM mould), the mould was initially polished with a release agent or wax to prevent the composites from sticking onto the mould upon removal. Firstly, AC from Komeng coconuts shell was weighted based on the percentage 8, 6, 4 and 2%. Then, PP were mixed as matrix into the AC with percentage 2, 4, 6 and 8% then finally encapsulated with epoxy resin. Finally, the mixture components were poured into the mould and left at room temperature for 24 hours until the mixture was hardened and compressed.

C. *Experimental methods*

Procurement of materials:

The experiment started with the procurement of the coconut shell specimens, resin, hardener, mold and roller. Coconut shells were procured from a local grocer. Six pieces of coconut shells were ground to form a powder with the diameters of 50 to 200 μm using a grinding machine. The density of coconut shell is 1.60 g/cm3 Polyester resin and hardener were procured from a local supplier in Madurai, Tamilnadu. The resin is polyester resin 3554A with the density of 1.15 g/cm3. The weight ratio of the resin and hardener was 4:1.

Preparation of Polyester/Coconut:

The dimensions and shapes of cavities were made according to the size and shape of the samples as per ASTM Standard D 638-90 for tensile testing and ASTM Standard D 790-97 for flexural testing. Polyester and hardener were mixed in a container and stirred well for 5–7 minutes. Before the mixture was placed inside the mould, the mold has initially been polished with a release agent to prevent the composites from sticking onto the mold upon removal. Finally, the mixture was poured into the mold and left at room temperature for 24 hours until the mixture was hardened

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D. *Preparation of Composites*

A mold of 300 mm × 300 mm × 15 mm having base of glass and sides of wood was used for casting the composite sheets. For quick and easy removal of the composite sheet a mold release sheet was kept over glass plate. The weight percents of coconut shell powder (i.e. 20, 30 and 40 weight %), was mixed with the matrix material consisting of epoxy resin and hardener in the ratio of 5:4.

The dimensions and shapes of cavities were made according to the size and shape of the samples as per ASTM Standard tensile testing and for flexural testing. Epoxy and hardener were mixed in the container and mixed thoroughly for 10 to 15 minutes for the uniform distribution of hardener otherwise fast exothermic reaction takes place and entire process gets spoiled. After that coconut shell particulate added to the mixture and stirred well for 10minutes for viscosity matching of particulate and resin.

Before the mixture is poured into the mould cavity a releasing agent (Mansion polish) were applied to the wooden mould for easy removal of specimen. Finally, the mixture was poured into the mould and left at room temperature for 48 hours until the mixture was hardened. When the composite were hardened, it was removed from the mold and finally composite were cured for 48 hours in room temperature.

III. EXPERIMENTATION PROCEDURE

A. *SPECIMEN PREPARATION*

The sets of ball particles were used to prepare the

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reinforced composites. Epoxy LY 556 resin, chemically belonging to the 'epoxide' family is used as the matrix. Its common name is BisphenolA Diglycidyl Ether. The low temperature curing epoxy resin (Araldite LY 556) and corresponding hardener (HY951) are mixed in a ratio of 10:1 by weight as recommended. The epoxy resin and the hardener are supplied by Ciba Geigy India Ltd.

The weight percent ratio of coconut powder and epoxy + hardener was selected as 10% : 90%. This filler weight percent was chosen because it had been reported by Harimi et al [8] that reinforcement of epoxy with a filler weight percent of 15% had clearly noticeable effect on the mechanical properties of the composite. The density of the epoxy + hardener was found to be 1.16 g/cc from the MSDS of the manufacture. The density was determined as 1.3847 g/cc (at 600 degrees) and 2.339 g/cc (at 800 degrees).

Materials used in this experimental work are Epoxy resin, Hardener and Coconut shell powder. Epoxy resin Moditite EL 301 is a thermosetting epoxy resin of medium viscosity supplied by Ruchi Organics Limited, Kanpur, Uttarpradesh, India having outstanding properties as the matrix material like excellent adhesion to different materials, high resistance to chemical and atmospheric attack, high dimensional stability, excellent mechanical properties, nontoxic nature and negligible shrinkage.

Hardener MH-933 is used to harden matrix material. The chemical composition of coconut shell powder consists of Lignin (29.4%), Pentosans (27.7%), Cellulose (26.6%), Moisture (8%),Solvent Extractives(4.2%), Uronic Anhydrides(3.5%) and Ash(0.6%).The cleaned coconut shells were crushed into small pieces by using hammer. These small pieces then converted into powder by using hammer.

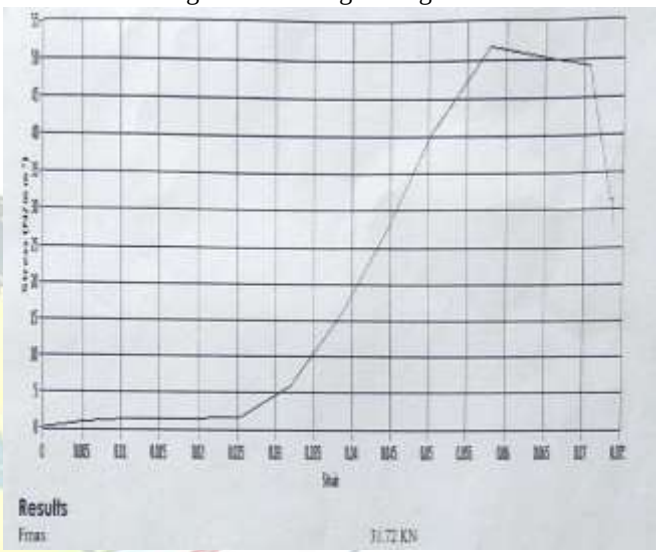
The collected powder was then sieved to different mesh sizes. For discriminating different CSP particle size about 1000g of CSP was put over the sieve shaker and shaken it for 20 min in shaker shown in Fig.1 (a). The sieves were arranged in the following order - crushed CSP, 600 micron (ASTM no. 8), 425 micron (ASTM no. 7), 300 micron (ASTM no. 6), 212 micron (ASTM no. 5) and then dust collector.

B. Mold preparation

Wooden board was taken and a Teflon sheet placed on it. A frame with square size stick of dimensions (15x6x0.6)cm was made using hammer. Heavy duty silicon spray was spread inside the frame to easily release the mould. The mixture was poured in to the frame and spread it thoroughly in order to avoid voids. When it will slightly harden, put one Teflon sheet on it and pressed it with various loads. After one day, the specimens ware taken out from the frame.

IV. RESULT

The mechanical properties of the coconut shell particle composite with the epoxy resin processed following the same procedure and the addition of the coconut fine crushed and the semi crushed particles results was discussed the maximum result was obtained the coconut fine crushed particles provides the most significant strengthening.



V. CONCLUSION

A In this project the coconut shell was prepared to the required natural composites based on coconut shell filler particles at three different filler contents via, 40% and 50% was prepared to ASTM standard. A mold of 300 mm × 300 mm × 15 mm having base of glass and sides of wood was used for casting the composite sheets. For quick and easy removal of the composite sheet a mold release sheet was kept over glass plate.

The weight percents of coconut shell powder (i.e. 40 and 50 weight %), was mixed with the matrix material consisting of epoxy resin and hardener in the ratio of 5:4. The dimensions and shapes of cavities were made.

After conducting the mechanical testing properties of the coconut shell particle composite with the epoxy resin processed following the same procedure and the addition of the coconut fine crushed and the semi crushed particles results was discussed the maximum result was obtained the coconut fine crushed particles provides the most significant strengthening.

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